AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

Frequency Control Work Plan

September 2021

Update

Important notice

PURPOSE

This publication is to provide an update on the power system frequency control related work that is being planned and progressed by AEMO.

This publication has been prepared by AEMO using information available at the time of publication. Information made available after this date may have been included in this publication where practical.

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VERSION CONTROL

Version	Release date	Changes
1.0	16/09/2021	Initial publication

Contents

1. Introduction

This report provides an update to AEMO's Frequency Control Work Plan[1], which was released in September 2020.

The frequency control work plan forms a key component of AEMO's ongoing work to prepare and support the changing NEM power system. The development of AEMO's frequency control work plan aims to facilitate effective communication of technical issues, prioritising the most urgent issues, and allowing them to be addressed in a cohesive way across industry.

Frequency control activities that are listed in the activity list (section 2.1) and schedule (section 2.2) are grouped under 5 workstreams, as shown in Table 1, below.

Table 1 Workstream objectives and outcomes

Objective	Workstream	Outcome
Secure and resilient frequency control under changing system conditions	Primary Frequency Response	• Implement broad-based primary frequency control.
	Inertia/ RoCoF/ EFCS	• Extended existing provisions to cover expected operating conditions for system security.
Efficient service procurement under lower inertia	Fast Frequency Response	• Efficient procurement of frequency related services.
Efficient and effective Frequency Control Ancillary Services (FCAS) services	Frequency Control Ancillary Services	• Adapting existing Contingency and Regulation FCAS services for current and emerging operating conditions.
Plan and manage system performance	AEMO frequency management tools	• Ability to model, plan, and operate the power system under expected and plausible operating conditions.

1.1 Key updates

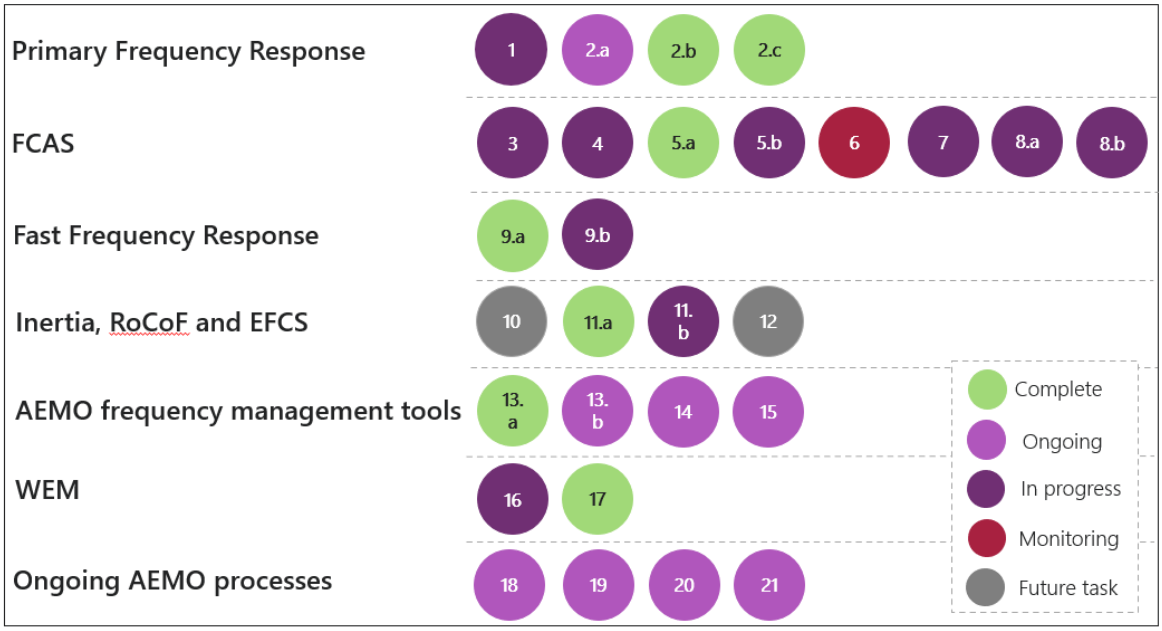
The last Frequency Control Work Plan update was published in March[2] 2021. Since then a further two tasks have been completed, and progress has been made on all other tasks except for those which remain future prospective tasks. Figure 1 illustrates the status of each task. The key update highlights are:

- Seven tasks are now complete
- Eight tasks are now ongoing processes
- Ten tasks are in progress and scheduled for completion soon
- Two tasks remain as prospective future tasks
- System requirements for the implementation of one task are being monitored

[1] See https://aemo.com.au/-/media/files/electricity/nem/system-operations/ancillary-services/frequency-control-work-plan/external-frequency-control-work-plan.pdf?la=en

[2] See https://aemo.com.au/en/energy-systems/electricity/national-electricity-market-nem/system-operations/ancillary-services/frequency-control-work-plan

Figure 1 Task status



Since the March update, several additional sub-tasks have been identified and added to existing task descriptions to better reflect requirements for task completion. Table 2 below describes any changes made to the tasks since the previous update.

Table 2 Changes to work plan tasks

ID	Description	Sub-tasks	Comments
2	Technical input into PFR incentivisation regulatory process: • PFR materiality and need for enduring requirements. • Incentivisation options review for small deviations. • Causer pays incentivisation feasibility	Task has been split as follows: • 2a) Data gathering and assessment of PFR rollout. • 2b(i) PFR Technical White Paper • 2b(ii) Incentivisation discussion paper • 2c) Frequency Operating Standard (**FOS**) Criteria Options Analysis.	
8	Consideration of appropriate regional FCAS requirements	Task has been split as follow: Develop & understand requirements for: • 8a) Regional regulation FCAS • 8b) Regional contingency FCAS	Regional regulation FCAS requirements have been prioritised due to emerging system security risk associated with significant proportions of regulation FCAS being provided by relatively few large grid-scale batteries.
9	Technical input into Rule Change (ERC0296) and implementation.	Task has been split as follows: • 9a) Technical investigation and implementation options for Fast Frequency Response (FFR) for Contingency management (system intact). • 9b) Implementation of rule change	Following the rule change final determination, AEMO has begun preparing for FFR implementation and will track implementation progress here.

See Table 3 below for an update on the current market ancillary services specification (MASS) review timelines and content. This details what frequency work plan related content is included in the listed MASS reviews.

Table 3 Recent and upcoming MASS reviews

MASS review	Year	Inclusions
Amendment of the MASS – DER and General consultation	2021	• Measurement requirements for DER participation in FCAS markets (Task 21) • Switched reserve limits for non-system normal conditions, such as for islanding conditions (Task 3) • New regulation FCAS provisions, including limiting response delay, setting minimum bid requirements and a range of data and telemetry requirements (Task 4)
Amendment of the MASS - FFR implementation	2022	• FFR market performance parameters (Task 7)

2. Activities and Work Plan

2.1 Activity List

The following table provides a current list of frequency control related work that is being planned and progressed across AEMO. These activities are also illustrated in the Activity Schedule in Section 2.2.

ID	Task	Description	Deliverable	Status[3,4]	Update
Primary Frequency Response					
1	Mandatory PFR Rule implementation	Facilitate implementation of Mandatory PFR Rule.	Facilitate implementation.	**In Progress**	All information and documentation relating to the implementation of the Mandatory PFR rule, including updates on the rollout are on the AEMO website. **Tranche 1 (> 200 MW DUIDs)**: Implementation settings commenced from late September 2020 and are complete for ~30.9 GW (as of August 2021). **Tranche 2 (80 – 200 MW DUIDs)**: Self assessments were due by 19 November 2020. Implementation of setting changes has now been completed for around 6.3 GW of Tranche 2 installed capacity (as of August 2021). **Tranche 3 (< 80 MW DUIDs)**: Self assessments were due by 17 February 2021. Implementation of setting changes has commenced or completed for around 2.1 GW of Tranche 3 installed capacity (as of August 2021).
2	Technical input on PFR Incentivisation Rule Change (ERC0263)	Technical input into PFR incentivisation regulatory process: • PFR materiality and need for enduring requirements.	2a) Data gathering and assessment of PFR rollout. 2b(i) PFR Technical White Paper	2a) **Ongoing** 2b) **Complete**; (i) Technical report & (ii) Discussion paper – August 2021 2c) Interim advice - **Complete**;	2a) All information relating to the PFR rollout is available on the AEMO website. 2b & 2c) AEMO have provided technical and regulatory advice to the AEMC's project team at various stages during the PFR incentive arrangements rule change consultation. Final advice provided to the AEMC include: the PFR Technical White Paper (which includes the FOS criteria options analysis) and PFR Incentivisation Options Discussion paper. Documents are available on the AEMO website.

[3] Indicative dates are calendar year. For example, Q2 2021 refers to April – June 2021.

[4] This publication has been prepared by AEMO using information available at the time of publication. Any changes to indicative dates following publication of this document will be communicated through appropriate channels.

ID	Task	Description	Deliverable	Status[3,4]	Update
		• Incentivisation options review for small deviations. • Causer pays incentivisation feasibility.	2b(ii) Incentivisation discussion paper 2c) Frequency Operating Standard (**FOS**) Criteria Options Analysis.	Technical report – September 2021	Technical reports, along with the draft determination were published to the AEMC website on 16 September 2021.
Frequency Control Ancillary Services (FCAS)					
3	Switched Reserve Limits	Applying appropriate limits to the total proportion of switched reserve, this is needed to ensure there is a minimum amount of dynamic frequency control.	Potential application of limit/constraint.	**In Progress**	The Frequency responsiveness of FCAS is under consideration as part of the 2021 General MASS Review. All documentation relating to the MASS review are on our dedicated webpage. An update on the MASS consultation is expected in September 2021. Under the Draft Determination published in June 2021, generalised limits on switched frequency response reserves will not be progressed at this stage. Rather, limits for non-system normal conditions, such as for islanding conditions would be progressed first.
4	Regulation FCAS improvement	Regulation FCAS improvements including minimum technical requirements.	Operational improvements (requirements would be reflected in the Market Ancillary Service Specification [**MASS**]). Additional work may follow, including further tuning of Automatic Generation Control (**AGC**) after system upgrade and consideration of regional Regulation FCAS requirements.	**In Progress**	AEMO conducted AGC tuning in December 2020 that improved usage of Regulation services in light of the significantly changed frequency distribution associated with rollout of the Mandatory PFR rule. The requirements for participation in Regulation FCAS are under consideration as part of the 2021 General MASS Review. All documentation relating to the MASS review are on our dedicated webpage. The Draft Determination introduced a range of new requirements relating to Regulation FCAS provision, including limiting response delay, setting minimum bid requirements and a range of data and telemetry requirements.
5	Constraint for Heywood Interconnector to manage UFLS inadequacy	Management of South Australia for loss of interconnector in periods where UFLS is insufficient to prevent cascading failure.	5a) Constraint implemented under SA Government Regulation 88A.	5a) **Complete** 5b) **In Progress**. Submission to	Initial constraint implemented on 9 October 2020, under Regulation 88A. Further information on the Heywood UFLS constraint can be found in this fact sheet. Analysis on protected event in progress.

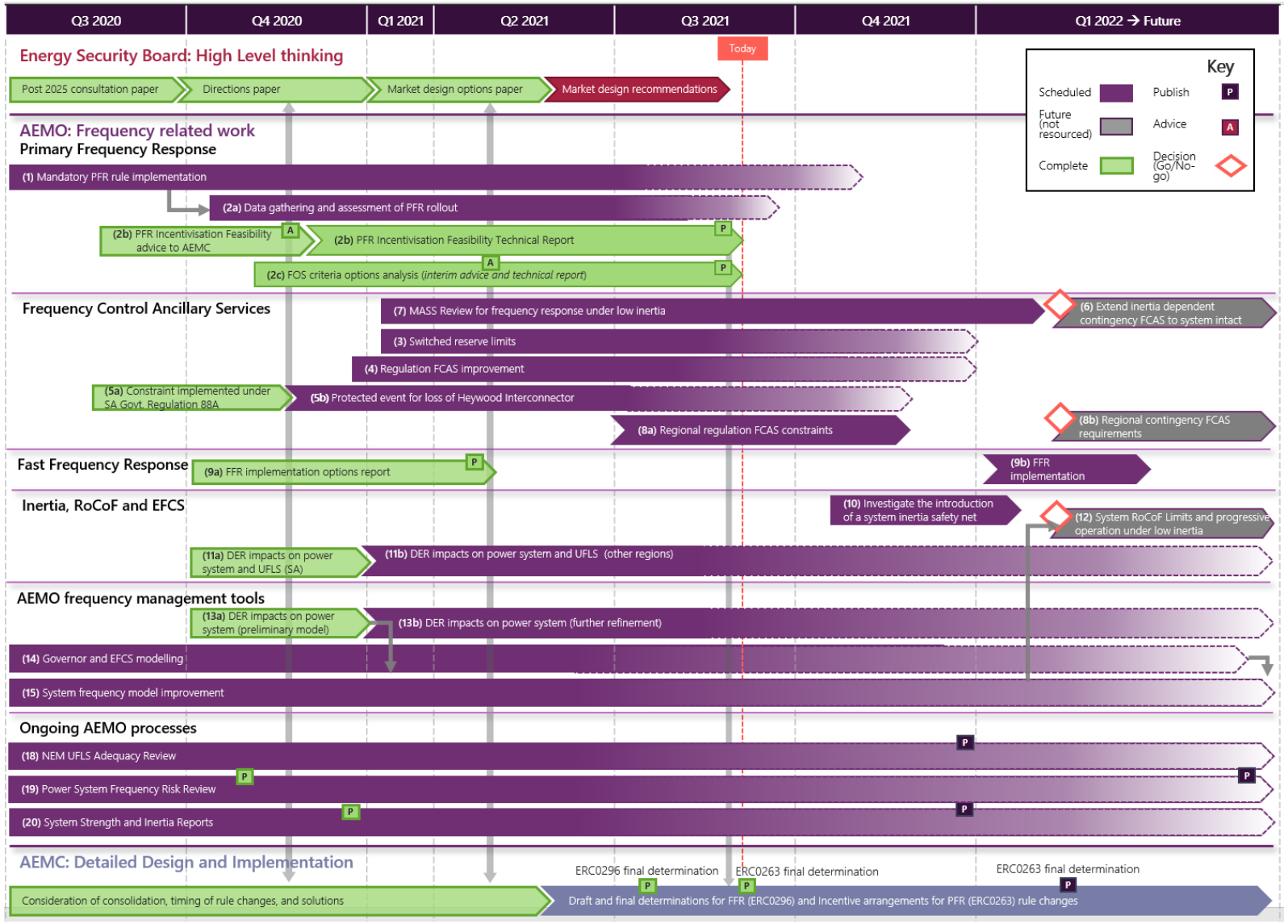
ID	Task	Description	Deliverable	Status[3,4]	Update
			5b) Protected event for loss of Heywood interconnector.	reliability panel anticipated this year.	
6	Extend inertia dependent contingency FCAS to system intact	FCAS constraints for inertia dependent contingency FCAS volumes for system intact.	FCAS constraints.	Monitoring	AEMO does not yet see the need for inertia dependent constraints due to inertia levels in the NEM, however this is being monitored. It is expected that these constraints will not be required in the near future.
7	MASS Review for Frequency response under low inertia	Examine how changing the definition of fast contingency FCAS services may impact the availability and performance of frequency control.	MASS review required following FFR Rule Change.	**In Progress**	The final determination for the AEMC's fast frequency response market ancillary service rule change was made on 15 July 2021 and will introduce two new fast frequency response (FFR) markets in October 2023. All information can be found on the AEMC website. AEMO's FFR Implementation options report provided to the AEMC as part of the rule change process reviewed multiple options for FFR services and recommended the introduction of standalone FFR FCAS market services. Under the rule change, AEMO is required to complete a MASS Review within 18 months of the rule change determination to specify the performance parameters for these FFR markets and progress implementation. AEMO is planning for the necessary MASS consultation likely to commence from Q1 2022.
8	Regional FCAS requirements	Consideration of appropriate regional FCAS requirements	Develop & understand requirements for: 8a) Regional regulation FCAS 8b) Regional contingency FCAS	8a) **In Progress** expected delivery in Q4 2021 8b) Monitoring need for prospective future task	8a) AEMO has identified risks with having too much regulation FCAS enabled from a single source and has a preferred approach to invoke constraints which will require a minimum proportion of regulation to be provided from outside of Victoria. Implementation will occur during Q4 2021. More information can be found here. 8b) A similar approach to that planned for regulation FCAS is being evaluated for contingency FCAS.
Fast Frequency Response (FFR)					
9	FFR options report (Technical Report) and Implementation	Technical input into Rule Change (ERC0296) and implementation.	9a) Technical investigation and implementation options for FFR for Contingency management (system intact). 9b) Implementation of rule change	**9a) Complete** **9b) In progress** (procedure/guideline development phase)	9a) The AEMC published the AEMO Technical Advice – Fast Frequency Response Implementation Options in April and the final rule determination was published on 15 July 2021. The report also detailed the potential impacts of FFR implementation on the availability of other FCAS services and inertia. All information can be found on the AEMC website. 9b) FFR performance requirements will be included in a forthcoming MASS consultation, which must be completed by the end of 2022. Further details on reform implementation timelines can be found on the AEMO website. Fast frequency response is currently in the procedure/guideline development phase, with development, implementation and registration to be completed over 2022 and 2023 for market commencement 9 October 2023.

ID	Task	Description	Deliverable	Status[3,4]	Update
Inertia, RoCoF and EFCS					
10	System inertia safety net investigation	Investigate the introduction of a system inertia safety net for the mainland NEM, under system intact conditions.	Analysis to inform AEMO inertia publications.	To commence by 2022. Publication date TBC.	N/A
11	DER impacts on Under Frequency load Shedding (**UFLS**)	DER penetration into UFLS	DER penetration into UFLS, 11a) South Australia/South Australia Power Networks. 11b) Other NEM regions	11a) **Complete** 11b) **In progress**	11a) Appendix A of the PSFRR contains further information on DER impacts on UFLS in South Australia and a suite of recommendations for mitigating risks to South Australian UFLS, including dynamic arming. 11b) UFLS data collection from NSPs now complete for Victoria, close to complete for New South Wales and Queensland. Analysis underway. Ongoing updates on AEMO's UFLS studies are provided here.
12	System RoCoF Limits and progressive operation under low inertia	Specify a set of system RoCoF limits (in addition to generator requirements) and other operational requirements for operation under progressively lower inertia. Assessment of Emergency Frequency Control Schemes (EFCS), including UFLS.	Potential future work leading off from current activities. Communicated for visibility only.	TBC Prospective future task.	N/A
AEMO frequency management tools					
13	Distributed Energy Resources (**DER**) impacts on power system	DER and load modelling (internal AEMO modelling improvement task).	13a) Preliminary model versions 13b) Ongoing refinement of models	13a) **Complete** 13b) **Ongoing**	Ongoing updates provided on AEMO's website.
14	Governor and Emergency Frequency Control Schemes (**EFCS**) modelling	Power System Frequency Risk Review (**PSFRR**) report including protected event recommendations	Governor and EFCS modelling for PSFRR.	**Ongoing**	Governor and EFCS modelling for 2020 PSFRR complete. There are ongoing efforts to ensure that frequency models are adequate to enable AEMO and NSPs to assess power system frequency performance, including as part of the 2022 PSFRR. As the industry continues to transition, these ongoing efforts are needed to ensure models and modelling tools are adequate for planning, operations, and the integration of new generator connections.

ID	Task	Description	Deliverable	Status[3,4]	Update
					A final determination on the General Power System Risk Review (GPSRR) rule change was published by the AEMC on 3 June 2021 on their website. Ongoing work is required in collaboration with NSPs, including for delivery of the first GPSRR by 31 July 2023.
15	System frequency model development	Updating existing system frequency model to be able to predict post-contingent frequency outcomes based on generating unit dispatch.	Base model and process for continual maintenance and improvement.	**Ongoing**	N/A
WEM					
16	Wholesale Electricity Market (**WEM**) Reform: Essential System Services	Reform of Ancillary Services provision in the WEM to new Essential System Services framework.	Rule changes, frequency control model, facility accreditation process and markets inputs for co-optimised Regulation, Contingency Reserve and Rate of Change of Frequency (**RoCoF**) Control (inertia) services.	**In Progress**	Details on the WEM Reform Program can be found on the AEMO website.
17	South West Interconnected System (**SWIS**) Real-time Frequency Stability Tool (WEM)	Online inertia monitoring and contingency simulation for control room	Operation tool, control room support and training.	**Complete**	Tool now in production.
Ongoing AEMO processes					
18	NEM UFLS Adequacy Review	Biannual Review	UFLS Adequacy Review	**Ongoing** Draft NEM UFLS review report will be published this year.	NSP datasets have been analysed. NEM intact and separations studies have also been finalised. Report is underway.
19	Power System Frequency Risk Review	PSFRR report including protected event recommendations	2020 PSFRR Stage 1 and Stage 2 reports	2020 reports **complete**	The 2020 PSFRR Stage 1 and Stage 2 reports are published on AEMO's website.

ID	Task	Description	Deliverable	Status[3,4]	Update
				Next report planned for 2022	The next PSFRR planned for delivery in 2022 for which AEMO has commenced development of the scope and methodology, including TNSP engagement. The GPSRR rule change final determination was published in June 2021 and requires AEMO to review non-credible contingency events and other events and conditions likely to lead to cascading outages, or major supply disruptions.
20	Minimum inertia requirements and any shortfalls	Inertia requirements and any shortfalls for each region of the NEM when islanded, which need to be published in the annual Inertia Report or via ad hoc updates where justified.	Shortfalls publication(s)	2020 Inertia Report **complete**. **Ongoing** shortfalls publications.	The 2020 Inertia Report is published on AEMO's website. Ongoing shortfall notices are also published to this webpage. The next Inertia Report is planned for December 2021.
21	Technology Trials	Facilitate trials in VPP, Inertia Measurement and Advanced Inverter applications.	Trial facilitation and post-trial activities	**Ongoing**	The requirements for DER participation in FCAS are under consideration as part of the 2021 DER MASS Review. All documentation relating to the MASS review are on our dedicated webpage. An update on the MASS consultation is anticipated in September 2021. Knowledge share reports and other information relating to the VPP demonstrations, which will conclude when the 2021 DER MASS Review concludes, is available on AEMO's website. AEMO's latest trial, Project EDGE, which is a collaboration between AEMO, AusNet Services and Mondo is underway. Further information on Project EDGE can also be found on AEMO's website. AEMO published the Application of Advanced Grid-Scale Inverters in the NEM white paper on 4 August 2021, calling for the fast tracking of advanced inverter trials.

2.2 Activity Schedule



Note: WEM and some ongoing tasks displayed in the activity list (section 2.1) are not shown in this diagram